AMSAT

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OBSERVATIONS ON THE SPACE CONFERENCE

Guest Editorial -- Gary Allsman, W5UEW

(Recently I had the opportunity to observe the amateur radio fraternity and one facet of its work from a position that not many of us from the hinterland, West Texas, often have the opportunity to do. I was fortunate to be in a position to take part in the preparation for and participate in the 1971 World Administrative Radio Conference for Space Telecommunications, WARC-ST, held this last summer in Geneva and thought the following comments would be appropriate on the eve of the A-O-C launch.)

The Amateur-Satellite Service came out fairly well at the WARC-ST but things could have been better. And as one might expect, favorable amateur influence in a large number of delegations could have been greater.

The IARU, with AMSAT providing technical support, was present as official observers and carried the ball for the amateur community so far as on scene support was concerned. The IARU was highly respected by all delegations and provided a strong and necessary favorable influence for amateur matters at the Conference. (As a side-light, some organization like the IARU must be on hand as a politically neutral source of information; often information from national delegations is looked upon as colored by national interests.)

But IARU presence at the Conference was not enough. A large majority of delegations come to a conference with a predetermined opinion on matters involving policy or politics in contrast to matters involving technical trade-offs. Amateur radio unfortunately often falls in the former category. This means the amateurs in each country must work to convince their own telecommunications officials to look favorably toward amateur matters before a conference begins. At a WARC each country has one vote and the favorable vote of just 8 or 9 additional countries at the Conference could have resulted in additional allocations for the Amateur-Satellite Service.

There is insufficient space here to try to categorize the various reasons why an administration comes to a conference with preconceived negative positions toward amateur radio. In a few smaller countries however these negative positions are often based on one or two negative encounters with individual amateurs or sometimes just a complete misunderstanding of what amateur radio really means and tries to do.

The activities of AMSAT provide new opportunities to educate high officials and provide favorable public relations. Possibly the glamour of space will open new doors and we can swing the telecommunications authorities in more countries around to see the advantages of making all aspects of amateur radio available to their citizens.

AMSAT NETS

by Bill Tynan, W3KMV

In order to keep everyone up to date on activities, AMSAT presently holds three regular nets. A net serving principally the eastern portion of the U.S. meets on 3855 kHz on the second and fourth Mondays of each month at 7:00 PM EST (2400Z Monday). After daylight savings time takes effect this net will move to 9:00 PM EST (0100Z Tuesday). A second net meets on 14,280 kHz on the second and fourth Sundays of each month at 1:00 PM EST (1800Z). After daylight savings time, this net will be held at 2:00 PM EDT (still 1800Z). Also on the second and fourth Sundays of each month at 1900Z, a third net meets on 21280 kHz. More check-ins for all nets are needed, particularly the 20 and 15 meter nets. A well-equipped station in Florida would be especially useful in order to augment coverage. Foreign stations are particularly invited to check-in. All of these nets will probably be held more frequently as the launch of A-O-C draws closer. Listen for the AMSAT club station call W3ZM on all nets and schedules.

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FROM THE PRESIDENT'S DESK - AMSAT-OSCAR-C

On January 6 the AMSAT Board of Directors made an important decision affecting our plans for the next OSCAR satellite. In view of the fact that several of the systems under development for AMSAT-OSCAR-B (A-O-B) have fallen far behind schedule and are not likely to be ready in time for our approved launch now scheduled for July, it was decided to prepare a second, more simplified spacecraft to meet our launch date. This simplified spacecraft, which we have been referring to as AMSAT-OSCAR-C (A-O-C), uses hardware already available or readily obtainable in the limited time available.

The two-to-ten meter linear translator and 24-channel Morse code telemetry encoders are planned for A-O-C, along with the WIA-Project Australis 35-function command decoder. The satellite structure which is similar to OSCAR's 3 and 5 is already available, and solar cell panels leftover from A-O-B are being configured for A-O-C's 24-volt nickel-cadmium rechargeable battery system.

Also being readied for A-O-C is CODESTORE, a shift-register memory device capable of storing messages in Morse code for repeated retransmission on the 29.450 MHz CW beacon. The memory length of A-O-C's CODESTORE unit is 768 bits, which is sufficient to permit storage of approximately 15 words in Morse code. The unit is set to retransmit messages at 13.4 wpm, a speed that will permit experiments of interest to teletype enthusiasts. At this speed, teletype characters can be recorded in CODESTORE and retransmitted to the ground at one-quarter standard 60 wpm teletype speed. To decode the teletype, one need only decode the keyed "ones" as mark pulses by tape recording the message at 1-7/8 ips and playing it into a teletype system at 7-1/2 ips. It should be possible to store teletype messages up to 96 characters long by this method.

We are currently collecting ideas on the types of messages we could use with CODESTORE. For example, all of the following messages are possible within the 768 bit limit of the CODESTORE memory:

"ORBIT 2109 1101Z AT 101W ADD 115R111 MIN AND 27R781 DEG PER ORBIT"

"HURR DONNA EXPECTED AT PUERTO RICO 9 SEP 21Z MONITOR 29R455 FOR EMERGENCY TRAFFIC"

"SERUM G URGENTLY NEEDED FOR INFANT AT MADRAS UNIV HOSPITAL ACK AVAILABILITY VIA CODESTORE"

"PLEASE MONITOR TEN METER BEACON DURING CURRENT IONOSPHERIC DISTURBANCE SEND REPORTS TO AMSAT"

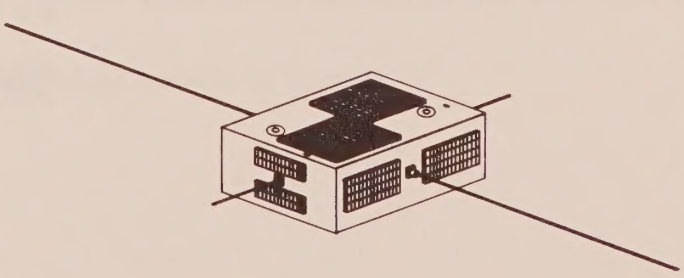
We would certainly welcome other ideas and suggestions on the use of CODESTORE.

A 435.10 MHz beacon transmitter with a power output of around 350-450 milliwatts is also under construction for flight, if it is completed in time. This beacon will be keyed with Morse code telemetry or CODESTORE, as selected by ground command.

A-O-C is planned to have a useful operating lifetime of around a year, so that if all goes well, it will hopefully last until A-O-B is launched. Notification concerning A-O-C has now been filed with NASA concerning the launch, and FCC requesting waiver of certain amateur regulations for OSCAR 6, the name of A-O-C after launch.

Given below is a table comparing the capabilities and characteristics of A-O-C with A-O-B. Also to be found in this issue of the "AMSAT Newsletter" is a list of the telemetry parameters to be transmitted by A-O-C, and information on A-O-C operations. Details on the two-to-ten meter repeater were given in the March 1971 issue of the "AMSAT Newsletter," and a description of the principle of operation of CODESTORE was in the June 1971 issue.

Perry I. Klein, K3JTE



AMSAT-OSCAR-C (Artist's Conception)

SYSTEM-LEVEL COMPARISON OF A-O-B AND A-O-C SATELLITES

by Richard Daniels, WA4DGU

	A-O-B	A-O-C
WEIGHT	50 lb.	35 lb.
DIMENSIONS	12 x 14 x 10 in.	17 x 12 x 6 in.
STRUCTURE	Modular	Non-modular
POWER		
Solar Panels	90% of surface	50% of surface
Voltage	14 V	24 V
Battery - 6 amp. hr. nickel-cadmium	12 cell	18 cell
Average Power	7.0 W	3.5 W
TELEMETRY	60 channel-teletype format	
	24 channel-Morse code format	24 channel-Morse code format
MESSAGE STORAGE	768 bit programmable shift register	768 bit programmable shift register
EXPERIMENT CONTROL	Under-voltage sensing, 4 internally controlled modes	2 modes, ground controlled
COMMAND	35 pulse commands	21 pulse commands
REPEATERS		
EURO-OSCAR	432 MHz up/144 MHz down, linear, 10 W PEP	
AUSTRALIAN	144 MHz up/435 MHz down, FM 4-channel hard-limited 1 W per channel	
AMSAT	144 MHz up/29 MHz down, linear, 1 W PEP	144 MHz up/29 MHz down, linear, 1 to 2 W PEP
BEACONS	in-band beacons within the passband of each repeater	29.45 MHz (in-band beacon within the repeater passband) 0.2 watt (A-1)
		435.1 MHz 0.35 to 0.45 W (A-1)

HARRY D. HELFRICH, W3ZM

by Donna King

AMSAT is deeply saddened by the passing of one of its most valued members, Treasurer Harry D. Helfrich, W3ZM, age 55, on January 6, 1972.

Treasurer and a member of AMSAT's Board of Directors, Harry's most valuable role was probably that of liaison in working with others at NASA in getting various projects accepted. He most recently had been urging approval of an amateur station (SKYLARC proposal) on board NASA's SKYLAB. Harry's administrative ability helped AMSAT function smoothly; he often hosted guests for the out-of-towners, Board of Directors meetings, and was always present for the bi-monthly AMSAT nets on 3855 kHz. Technically knowledgeable, he handled tracking and data reduction for Australis-Oscar-5, built a number of small hardware articles for the A-O 5 spacecraft, and put together and narrated AMSAT's only tape-recorded history of that project.

Harry's early years in amateur radio led him to his first job in the CCC during the Depression, through college and training at the U.S Naval Academy, and into a career in the U.S. Navy, earning him the title of Captain Harry D. Helfrich. Retired, he worked for the Martin Company and then NASA's Goddard Space Flight Center. At Goddard, Harry's interest in "hamming" was renewed through AMSAT.

Harry leaves behind not only his wife, Dana, and four children at Annapolis, but also many and varied friends. Harry was one of the initiators of the 75-meter phone competition to contact two-letter call stations in all fifty states. He was working very hard toward this goal and his last amateur effort was recorded as attempting to reach the 50th state (Alaska). In appreciation of his efforts, the competition has been named in his honor.

AMSAT has requested and gratefully received Harry's call, W3ZM, as their own. Members hope to keep alive in his memory the effort and enthusiasm he gave to the organization.

OSCAR 6 AND OPERATIONS

by Bill Tynan, W3KMV

The launch of AMSAT-OSCAR-C, to be known as OSCAR 6 once in orbit, is drawing close. In order for the amateur community to realize the maximum benefit from the new OSCAR, an operations organization must be set up prior to launch. This organization must then function in the period just prior to launch through the launch day itself and during the operational lifetime of the satellite which is expected to be over a year.

The particular structure of this organization and its methods of operation will depend very much on what stations and individuals volunteer to assist with it. This article is intended to provide some of the requirements which the operations organization must fulfill rather than attempt to exactly define it at this time. It is also hoped that this article will serve to recruit volunteers who can offer assistance in meeting the requirements as set forth herein.

First a little background: The operations function falls, naturally enough, under the Vice President of Operations. It is the function of this AMSAT officer to organize all activities connected with operations. Since operations is a big job, the Vice President of Operations cannot do all or even a substantial part of the task himself. He must have volunteers to assist him in the various areas of responsibility.

What are some of the various areas of responsibility and what types of amateurs can help in each?

The areas can be categorized roughly as follows:

Control
Command
CODESTORE Loading
Data Retrieval
Communications
Data Processing

Let's examine each to see what the job entails.

Control

The control function is that of direction of the entire network of OSCAR operations. For example, in the area of command no command station will be authorized to send any command to the satellite without specific instructions from control. Control will not be in the hands of a single individual, but instead it will probably be vested in a committee which will include the President, Vice President of Engineering, Vice President of Operations and the Spacecraft Project Manager.

Command

A few, perhaps six or eight, strategically located, well equipped stations will be needed to be able to send commands to the satellite. These commands will instruct the spacecraft to perform various functions. (See the command list on page 9 of this issue.) It is presently envisioned that one such station will be located in the Washington area in order to have a short communications link between control and one station capable of commanding OSCAR 6. Three other command stations are expected to be located in North America, one in Connecticut, one in the Montreal area (we already have a volunteer) and a West coast station in Barstow, California. (We also have a volunteer for this.) One and possibly two would be located in Europe and/or Africa (we need volunteers) and three in Australia and New Zealand. One of these would be in Western Australia, one in the east and the third in New Zealand. WIA-Project Australis is seeing to the establishment of these stations.

CODESTORE Loading

The same stations established for command will probably also be equipped for CODESTORE loading. However, in order to provide flexibility in the kinds of experiments which can be conducted with CODESTORE, additional stations may also be set up for this function. Volunteers in remote areas are especially sought. Less control will be exercised over this function than will be the case with commanding the satellite, but, nevertheless, it will be a "No-No" for a CODESTORE loading station to load a message like "73's to Joe WB3XXX on his birthday." CODESTORE will be used principally to transmit orbital information in Morse code. For example, the message "orbit number 2109 had an ascending node equatorial crossing at 1101 GMT at 101 degrees west longitude. For later orbits add 115.111 minutes to the time and 27.781 degrees to the longitude per orbit would read "ORBIT 2109 1101Z at 101W ADD 115R111 MIN AND 27R781 DEG PER ORBIT." In addition, emergency or simulated emergency messages are expected to be loaded. A simulated message might read "SIM HURR SUSAN AT 70W 20N AT 2100Z 9SEPT MOVING NNW AT 60KTS WINDS 80 KTS." Another example of the kind of message to be sent via CODESTORE is "PSE MONITOR TEN METER BEACON DURING CURRENT IONOSPHERIC DISTURBANCE SEND REPORTS TO AMSAT." CODESTORE can be a very useful device if it is not used in a frivolous manner.

Data Retrieval

Data retrieval can be accomplished in two general ways. As has been stated elsewhere in this issue, telemetry for A-O-C (OSCAR 6) will be in the form of Morse code numbers. These can be copied down by hand and then translated to the desired information by the use of formulae. The results could then be mailed to AMSAT or sent via HF radio links on voice, CW or RTTY. Another method would be to tape record the raw Morse code telemetry and retransmit it in some manner to AMSAT for decoding.

Communications

The job of communications is perhaps the most difficult, yet it should be the one in which we as radio amateurs should shine. Right now, for example, the task of keeping the various schedules with Australia and Germany is taxing those who are doing it. Of necessity some schedules must be early in the morning or late at night. At this moment a need exists for stations in the Washington area well equipped for HF SSB and/or RTTY to help with these schedules. As launch day approaches this need will multiply and become one of a worldwide nature. We must be able to provide late information to amateurs throughout the globe on the impending launch. When launch day arrives we should be able to obtain and disseminate up to the minute information on the countdown, orbital insertion, spacecraft separation, first reception of signals from OSCAR 6 and initial orbital information. The launch day network for Australis-OSCAR 5 was rather hastily put together and did a rather fine job under the circumstances, but it did depend heavily on NASA and other non-amateur communications for its operation. Let's try to make it more of an amateur show this time.

I can think of a need for good SSB stations in the following places to make the net function:

1. A station in California at or near the launch site possibly linked up by FM with a portable station at the launch site itself if this can be arranged.

2. At least four stations in the Washington area to communicate with the West coast station and others to be described.

3. One and possibly more stations in Europe to relay to following Europeans and to the U.S. first information on operation of OSCAR 6 including initial telemetry data after separation from the launch vehicle.

4. A station in Madagascar to report on orbital injection and separation. During the A-O 5 launch, this function was performed by Chet Cunningham, 5R8AS, but he is no longer there.

5. Several stations in South America to spread the word in that part of the world and to report back on use of the repeater and on telemetry data.

6. One or more stations in the northern part of the U.S. or eastern Canada to relay information on first North American reception of OSCAR 6.

7. Several stations in Australia and the South Pacific area to provide reports and disseminate information in that part of the world.

8. A general amateur broadcast facility. This function will be supplied by W1AW and possibly a West Coast station as well as others spread around the world.

This is in the nature of a minimum launch day set-up. Obviously other stations in various parts of the world, particularly in areas of high ham population such as Japan, will be very useful additions.

After the launch day the network can settle down to a little less frantic pace, but nevertheless, communications will be needed from Washington to the various command and CODESTORE loading stations. Also, telemetry data coming the other way must be provided for.

Data Processing

As said previously, converting OSCAR 6 Morse code telemetry data into useful form can be done by hand but this is a tedious and time-consuming process when many samples are involved. A better way would be to automate the operation. By the use of a Morse code to teletype converter (several such devices have been in the amateur magazines recently) it would be possible to convert the telemetry into a form useful to a digital computer. By the use of a suitable program, the computer can then print out the data in engineering form, i.e., volts, amps, degrees Centigrade, etc.

AMSAT members at various locations may wish to set up such facilities. Two such efforts are underway here in the Washington area including one utilizing an entirely "home brew" computer.

This aspect of the operations effort should prove very interesting to those hams who have or want to gain a knowledge of digital computer techniques. Having more than one or two of such data processing set-ups should be beneficial in providing redundant sources of data and in providing checks between set-ups.

Well, there it is. It is a big job we have to do. Decide which operations activity you wish to participate in and volunteer. Once we have volunteers we can begin to establish the specific organization needed to support OSCAR 6.

In the meantime we can begin our communications set up by participating in the 3 AMSAT nets already in operation. See AMSAT nets elsewhere in this issue for details.

A-O-C DATA TO BE TELEMETERED BY THE MORSE CODE TELEMETRY ENCODER

Parameter	Unit	Parameter Range	Chan. No.	Approximate Calibration Data/Comments
Composite Array	I (ma)	0 to 500 ma.	1	I_T = 5.00 N*(ma.)
+X Solar Panel	I (ma)	0 to 100 ma.	2	I_{+X} = 1.00 N (ma.)
+Y Solar Panel	I (ma)	0 to 200 ma.	3	I_{+Y} = 2.00 N (ma.)
+Z Solar Panel	I (ma)	0 to 400 ma.	4	I_{+Z} = 4.00 N (ma.)
-X Solar Panel	I (ma)	0 to 100 ma.	5	I_{-X} = 1.00 N (ma.)
-Y Solar Panel	I (ma)	0 to 200 ma.	6	I_{-Y} = 2.00 N (ma.)
-Z Solar Panel	I (ma)	0 to 400 ma.	7	I_{-Z} = 4.00 N (ma.)
Charge or Discharge	I (ma)	-.5 to +.5 amp.	8	I_{BAT} = 10.00 N -500 (ma.) Battery charge or discharge I.
Unregulated Bus	V	18V to 30V	9	V_{BUS} = 0.12 N +18.0 (volts)
½ Battery	V	0 to 15V	10	$V_{½BAT}$ = 0.15 N (volts)
Switching Reg.	V	0 to 15V	11	V_{SR} = 0.15 N (volts)
Battery Temp.	^{o}C	-30 to +50^{o}C	12	T_{BAT} = -1.471 N + 95.79 (^{o}C)
Baseplate Temp.	^{o}C	-30 to +50^{o}C	13	T_{BP} = -1.471 N + 95.79 (^{o}C)
Transponder P.A. Temp.	^{o}C	-30 to +50^{o}C	14	T_{PA} = -1.471 N + 95.79 (^{o}C)
+X Panel Temp.	^{o}C	-30 to +50^{o}C	15	T_{+X} = -1.471 N + 95.79 (^{o}C)
+Y Panel Temp.	^{o}C	-30 to +50^{o}C	16	T_{+Y} = -1.471 N + 95.79 (^{o}C)
+Z Panel Temp.	^{o}C	-30 to +50^{o}C	17	T_{+Z} = -1.471 N + 95.79 (^{o}C)
Transp. P.A. Emitter	I (ma)	0 to 500 ma	18	I_{PA} = 5.00 N (ma)
Transp. Sw. Reg.	V	0 to 30 V	19	$V_{T.S.R.}$ = 0.30 N (volts)

Parameter	Unit	Parameter Range	Chan. No.	Approximate Calibration Data/Comments
Spare	--	--	20	Spare
Transponder R.F. Power	W	0 to 10W	21	$P_{OUT} = 0.001\ (N)^2\ (W)$
Beacon R. F. Power	mW	0 to 1W	22	$P_{OUT} = 0.10\ (N)^2\ (mW)$
Transponder AGC	V	0 to 3V	23	$V_{AGC} = 0.03\ N$ (volts)
Midrange Cal.	V	0 to 1V	24	N = 50 counts ± 1
				*N = Value telemetered (omit most significant digit which identifies the data line number)

LIST OF COMMAND FUNCTIONS FOR A-0-C

1. 2M/10M Transponder ON
2. 2M/10M Transponder OFF
3. 435 MHz Beacon Transmitter ON
4. 435 MHz Beacon Transmitter OFF
5. Code Store - Run Mode
6. Code Store - Load Mode
7. Morse Code Telemetry Encoder - High Bit Rate (20 wpm)
8. Morse Code Telemetry Encoder - Low Bit Rate (10 wpm)
9. Transponder A.G.C. Loop Enabled
10. Transponder A.G.C. Loop Disabled
11. Command Code-Store to Modulate 435 MHz Beacon
12. Command Morse Code Telemetry Encoder to Modulate 435 MHz Beacon
13. Command Code-Store to Modulate Transponder Beacon
14. Command Morse Code Telemetry to Modulate Transponder Beacon
15. Disable Commands 13 & 14/Enable Clock Sequence (Switches Between Code-Store and Telemetry once every 15 minutes)
16. Enable Command 13 or 14 (whichever was last commanded)/ disable clock sequence
17. Reset Clock
18. 2M/10M Transponder ON (Redundant)
19. 2M/10M Transponder OFF (Redundant)
20. 435 MHz Beacon Transmitter ON (Redundant)
21. 435 MHz Beacon Transmitter OFF (Redundant)

PROPAGATION PREDICTION FOR AMSAT-OSCAR-C

by Raphael Soifer, K2QBW

Propagation through AMSAT-Oscar-C (A-O-C) will be much like that experienced with Australis-Oscar 5 (AO-5), the principal difference factor being A-O-C's higher power output -- about one watt as opposed to AO-5's 180 milliwatts when first launched. Ionospheric factors, not particularly pronounced with AO-5 on line-of-sight paths, should be even less of a problem with A-O-C. During AO-5's lifetime in orbit, smoothed sunspot numbers held steady at 106, very close to the cyclical high of 111. By comparison, W3ASK predicts a smoothed sunspot number of 43 for July 1972, declining to 28 by July 1973.

The main operational difference, of course, is that A-O-C is a translator, and has an uplink as well as a downlink. Recent ground tests using the A-O-C receiver showed that a received signal level of -130 dBW will be required to drive the ten-meter transmitter to full power output in a single-signal condition. Assuming a slant range of 2000 statute miles, an uplink frequency of 145.9 MHz and a zero dB average gain receiving antenna, path loss calculations give a required e.r.p. of about 80 watts or 50 watts into a dipole antenna in order to attain full downlink power. This calculation assumes an arbitrary loss factor of 3 dB for polarization mismatch; during peaks of Faraday rotation fading, signals would be 3 dB better, during nulls, somewhat worse. With 100 feet of RG-8/U and 60% transmitter efficiency, approximately 160 watts input will be required with a dipole antenna. Use of a four-element beam at the transmitting station would cut required power to about 7 watts output at the antenna or 23 watts input. Clearly the uplink will not pose a problem.

As was the case with the AMSAT aircraft flights, the downlink poses far more serious constraints. There are several components to the downlink calculation -- free space loss, receiver noise, antenna noise and ionospheric losses. Let us take these in order.

For the same conditions specified above in the uplink calculation -- 2000 miles slant range, dipole antennas, 3 dB polarization mismatch and 100 feet of RG-8/U, free space loss at 29.5 MHz works out to approximately 132 dB including provision for antenna gains and line losses. For a receiver meeting usual amateur specifications -- 0.5 uv. for 10 dB S/N in a 2.1 kHz bandwidth, receiver-generated noise is approximately 1.26×10^{-16} watts. To this must be added antenna noise. For a quiet location at 29 MHz, this will consist primarily of galactic noise with an average value of 8.4×10^{-16} watts. The receiving noise threshold for a quiet location would be the sum of these or just about exactly -150 dBW. The noise level could be perhaps 2 dB lower due to variations in galactic noise, or it could be as much as 20 dB higher for an amateur in a noisy urban location. We will assume a quiet location and an average noise level of -150 dBW.

With a smoothed sunspot number of 43 or less, ionospheric blockage due to F_2 refraction ought to be negligible, except perhaps near midday at equatorial latitudes. For most amateurs in the U.S., Europe and Australia, F_2 blockage, which was minimal with AO-5, should be just about non-existent. Similarly, nondeviative absorption at noon for 40 ^{o} latitude is predicted to be 2 dB or less for elevation angles of 5^{o} or more (distances to subsatellite point of 2050 statute miles or less). For elevation angles of 20^{o} or more, absorption should be negligible. This is not to say, however, that the ionosphere will not make itself felt. Blockage due to sporadic-E, when present, could take the signal out entirely. Particularly on paths traversing auroral latitudes, scintillation and flutter-type fading will be noticed in much the same way as with AO-5. These effects were particularly pronounced during ionospheric storms and not too much of a problem during quiet conditions. Depending upon the propagation path and whether or not a storm or sporadic-E is in progress, the ionosphere could cause sporadic signal outages or severe distortion. Under normal conditions, however, it is predicted to be relatively transparent at night and to absorb less than 2 dB of signal during the day. Faraday rotation, of course, will be present at all times and was discussed earlier.

Putting all of these assumptions and calculations together, typical daytime S/N might be 16 dB for 2000 miles slant range and 18 dB at night. For a direct overhead path (900 miles slant range), nondeviative absorption would be negligible at all times and S/N would be approximately 25 dB. All of these predictions, of course, assume that just one signal is using the satellite at a time and is driving the translator to full power (one watt output). DJ4ZC, in AMSAT correspondence, calculates that for a large number of SSB signals, translator output for any one signal would be down by about 7 dB. For a large number of CW signals, the degradation of each signal would be somewhat greater. For a large number of strong steady carriers, the power of each would of course be 1/n.

Antenna Suggestions

If several stations use the satellite at once at a slant range of 2000 miles, the S/N for each of 9 to 11 dB will probably be inadequate for all but the scratchiest SSB communication. For comparison it has been estimated that SSB communication under fading requires an average S/N of 15 dB in a 2.1 kHz bandwidth for 90% intelligibility of spoken syllables. So-called "good commercial quality" would require about 30 dB. Another way to look at this is that 7 dB below full A-O-C output is just about where AO-5 was. Think back to your AO-5 results on ten meters -- if that steady carrier had been voice SSB, could you have understood it? Most amateurs with beam receiving antennas probably could have, at 2000 miles slant range. Those using simpler antennas, such as dipoles not too high off the ground, could have copied SSB from AO-5 only at shorter ranges and higher elevation angles. Moral: If you want to work long ranges using A-O-C on SSB, put up a good, high ten meter beam now. Adding 8 dB antenna gain would bring the S/N up to quite usable, if not commercial-quality, standards.

It happened with AO-5 and it will happen again. Many amateurs, experiencing signal dropouts at high elevation angles, blamed the ionosphere. It isn't the ionosphere, it's that DX-special antenna which concentrates all of your signal into low angle radiation, with a resultant drop-off in performance at the higher angles. Those amateurs wishing to utilize the close-in passes of A-O-C to best advantage should put up a high-angle ten-meter antenna. A turnstile, with 90° phasing between the two elements and between 8 and 12 feet (for 2 meters, between 19 and 27 inches) above ground, is an excellent choice. Such an antenna is simple to construct, will work well at all elevation angles above about 40°, will be omnidirectional in the horizontal plane (no tracking at all) and even provides some measure of reduction in Faraday fading -- at 90° elevation, no fading at all. Well-equipped stations ought probably to have two antennas, a good beam on a tower for DX and a low turnstile, as described, for "local" communication using A-O-C.

Bibliography

Soifer, "Australis-Oscar 5 Ionospheric Propagation Results,"
QST, October 1970.

Doyle, "10 Meter Anomalous Propagation with Australis Oscar,"
CQ, May 1970.

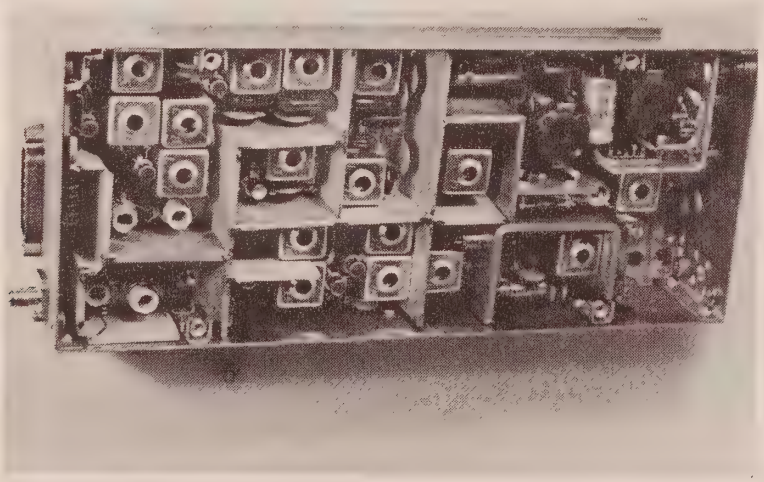
Jacobs, "Sunspot Cycle 20: Progress 1971 - Prediction 1972,"
CQ, January 1972.

Barghausen et al, "Predicting Long-Term Operational Parameters of High-Frequency Sky-Wave Telecommunication Systems,"
ESSA Technical Report, May 1969.

Hyder, "Atmospheric Noise and Receiver Sensitivity,"
QST, November 1969.

Davies, Ionospheric Radio Propagation, National Bureau of Standards, 1965.

The A.R.R L. Antenna Book, 12th Edition, 1970.



The Two-to-Ten Meter Repeater A-O-C Flight Unit Built by WA4DGU (Jan. 1972)

SKYLARC PROPOSAL TURNED DOWN

The following letter was received recently from NASA concerning AMSAT's proposal to provide a ten-meter amateur station for NASA's SKYLAB manned orbiting laboratory scheduled for flight in 1973 (see the December 1971 issue of the "AMSAT Newsletter"):

Dear Dr. Klein:

As you know, the AMSAT proposal to provide a radio amateur communications package for leisure time use by the crew on Skylab has been the subject of serious consideration within the Skylab Program for some time now, and more recently, by the top management of NASA.

It is with real regret that I must inform you that, in spite of the broad appeal of your concept and a generally favorable disposition to encourage AMSAT activities, NASA has concluded that we cannot add it to Skylab at this stage of the program; and, therefore, we must reject your proposal.

The decision involved many factors difficult to summarize briefly, including concerns for the priority of this proposal relative to other program additions that are also under consideration, the funds for the necessary integration and testing, and concerns for even a small additional diversion of management and engineering attention at a critical time in an extremely complicated program.

Our conclusion was not an easy one to reach. Considered by itself, the proposal appeared feasible and reasonable--one that we could not reject out of hand. It may be of some solace to you that I brought the subject to the attention of Dr. Fletcher (NASA Administrator) and Dr. Low (Deputy Administrator) because of the uniqueness of the proposal, and that the final decision was made by them, and then only with reluctance.

Should you desire, Mr. William Schneider, Director, Skylab Program, would be pleased to give you a more complete debriefing on our decision.

Sincerely,

s/

Dale D. Myers
Associate Administrator
for Manned Space Flight

AMSAT'S NEW TREASURER, DR. WILLIAM A. HOOK, W3QBC

William Hook, W3QBC, has been a ham since 1949 and holds an Advanced Class amateur license. Professionally, he is a Research Microbiologist at the National Institutes of Health, Bethesda, Maryland. His work at NIH has been primarily in the field of immunological mechanisms in oral and systemic disease. He has been Secretary-Treasurer of the NIH Amateur Radio Club since 1969 and has been active in the Medical Information Net (MEDINET). He has served as AMSAT's liaison with the U.S. Public Health Service in regard to providing communications concerning medical information and emergencies with radio amateurs in isolated areas. He is a past president of the University of Maryland Amateur Radio Association and is a member of Montgomery County RACES. He recently assumed the duties of the AMSAT Treasurer and is also responsible for the membership mailing list.

LETTERS TO THE EDITOR

Radiohams in Africa have always followed your outstanding contribution to space communications for a number of years and well remember December 12, 1961, as the lift-off date of Oscar I; it will never be forgotten.

Although we represent just a small part of the African Hamdom, we want you to know how grateful we are for what you have done. We wish to extend AMSAT our heartiest congratulations on the 10th Anniversary of the launch of Oscar I.

Our group in Benguela is carrying out experiments in VHF, on the 144 MHz band, and we are deeply interested in space communications, satellite tracking, etc. Therefore we would appreciate receiving complete literature, including a "how to get started" chapter, as we should still have the possibility of tracking Oscar 6 in early 1972.

It would be to our advantage if you would kindly send us all possible information, as we are very eager to participate in your space program and have no material at all to work on.

We would like to thank you for any assistance you may be able to render and look forward to receiving your news in the near future.

On behalf of the Benguela Radiohams group,

stations: CR6 AR, CR6 IV, CR6 IK, CR6 IS, CR6 FW, CR6 YS (y1), CR6 YY (y1), CR6 DN

(Ed. Note: Sam Segner of West Long Branch, New Jersey, a recent AMSAT member, suggests the following experiments for Oscar 6:)

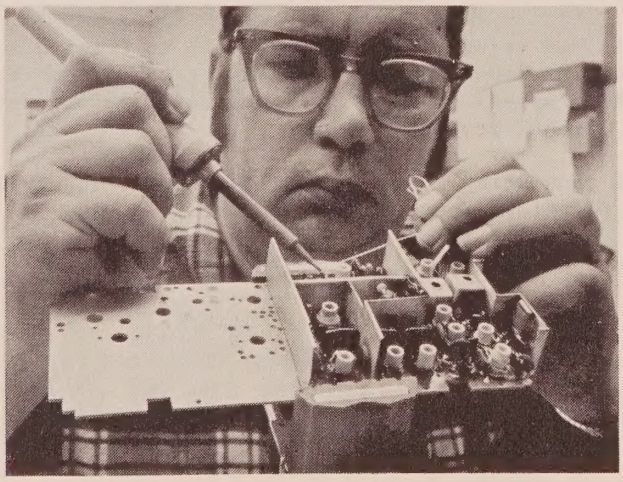
1. SSB Multiple Access - One station acts as a master and sends carrier (pilot) through satellite repeater. Other stations use pilot to correct for frequency errors, doppler shift, etc., and stack up at preselected or real-time assigned offsets. Also operate power control based on directions given by master station's channel. Objective is to determine minimum guard band possible and power allocation tolerance. Note: I believe that for the quality of signal usable by amateurs, even non-linear repeaters will work well, even hard limiters if multiple signals are present.

2. Accurate worldwide timing by having master station send up pulses and receive its pulses so that they go through satellite at prescribed WWV time. The slave stations offset so that their signal pulses are a prescribed relation in the satellite to the pulses of the master station, e.g. in phase but slightly offset in frequency.

3. Position location by ranging on satellite and using first order position of satellite based on broadcasts of each ascending node.

(Ed. Note: Also, Ted Mathewson, W4FJ, of Richmond, Virginia, sent in some other good ideas for experiments on future satellites:)

---A strong plea that if at all possible some sort of beacon on 435 MHz be put aboard A-O-B in July --- with the transition from 432 to 435 it seems essential to shift our thinking, listening, building, etc. The 2-10 seems retrogressive at least as far as the VHF/UHF group is concerned. The dire need is to get more people equipped on 432/5 before the Australian/German transponder is launched.



Wally Mercer, W4RUD, Assembles the Two-to-Ten Meter Repeater Prototype Unit (Aug.1, 1971)

THE SECRETARY'S COLUMN

The countdown for the next launch is getting closer and your plans for participation should be finalized soon. Previous and forthcoming articles in these Newsletters, QST, CQ and other magazines should be read to insure that your equipment is ready and operating procedures fully understood. The anticipated operating life of one year or more makes it very worthwhile to join in this program. The use of two and ten meters permits the maximum number of amateurs to participate.

There has been one Board of Directors meeting so far this year. Summary minutes are given below.

In remembrance of our esteemed past Treasurer Harry Helfrich, W3ZM, a donation was made to the Heart Fund. AMSAT will truly miss his dedicated service and helpful advice. Harry's call letters have been reassigned to AMSAT in his memory with Bill Tynan as Station Trustee.

In the coming months encourage your fellow amateurs to join AMSAT and to participate in the use of the upcoming OSCAR 6 satellite.

Charles Dorian, W3JPT

Board of Directors Meeting - January 6, 1972

The meeting was called to order shortly after 8 p.m. at the apartment of K3JTE with the following in attendance:

Frank Briden	Jan King
Dick Daniels	Perry Klein
Bill Dunkerley (by telephone)	Cap Petry
Shelly Glick (by telephone)	Ray Soifer
George Kinal	Bill Tynan

We were all deeply saddened by the news of the sudden death of AMSAT's dedicated treasurer, Harry Helfrich, W3ZM, and it was agreed to make a donation to the Heart Fund in Harry's memory. George Kinal, K2MBU, as first alternate director, will fill the vacancy on the Board of Directors. Possible candidates to serve as Treasurer were discussed. Bill Hook, W3QBC was subsequently contacted and agreed to serve as Treasurer; his appointment was later approved by the Board of Directors.

The upcoming ITOS-D (Improved Tiros Operational Satellite) launch on which NASA has agreed to fly OSCAR 6 was discussed. The launch still appears likely to take place in late June or early July of this year. Because of the delays in receiving much of the flight hardware for AMSAT-OSCAR-B, it was evident that A-O-B would not be completed in time for the ITOS-D launch. After considerable discussion, it was decided to prepare a less complex spacecraft (AMSAT-OSCAR-C) for flight as OSCAR 6, using hardware already available or nearing completion. Approval was given to prepare a letter to NASA Headquarters informing them of the change in payload.

It was reported that NASA had rejected AMSAT's proposal to furnish a ten-meter amateur station on NASA's SKYLAB-A manned orbiting laboratory (the SKYLARC - SKYLAB Amateur Radio Communications project.) It was decided not to appeal this decision, especially considering the recent death of Harry Helfrich, who had been SKYLARC project manager.

The AMSAT letter to ARRL requesting League financial support for 1972 was approved for submission to the ARRL Board of Directors meeting January 20-21.

The meeting adjourned around 11 p.m.

Perry Klein, K3JTE

SAMPLE TELEMETRY FRAME

(Simulating A-O-C Flight Data)

by Jan King, W3GEY

HI	163	132	102	141	
	202	235	200	263	
	352	380	368	355	
	457	452	453	458	
	558	524	530	500	
	633	600	687	650	HI

Using the above data one can answer the following questions (remember to drop the most significant digit which is used for data line identification and is not part of the telemetered value):

1. What is the approximate spacecraft attitude relative to the sun line? Which faces are being illuminated?

2. What is the total power being generated by the solar arrays at the instant the measurement was made?

3. Is the spacecraft running on a positive power budget at the time the measurement was made? (i.e., Is the battery being charged or discharged?)

4. What is the state of charge of the battery? This is a function of the battery voltage (Unregulated Bus Voltage).

5. What is the change of temperature (thermal gradient) across the spacecraft?

6. Is the temperature of the power amplifier transistor running at a temperature very close to that of the spacecraft baseplate? This will influence the P.A. efficiency.

7. What is the transponder usage at the time of the measurement? Is the activity high or low?

8. At what efficiency is the transponder power amplifier running? The P.A. runs from the 24v unregulated bus.

9. What is the status of the 435 MHz Beacon?

10. Does the telemetry encoder appear to be in calibration?

The next Newsletter will give sample calculations for all of the above examples. We also will be able to publish the exact telemetry calibrations.

ZIPSAT

The Independent Tracking Coordination Program, 824 Connecticut Ave., NW., Washington, D.C. 20006, is offering, on a subscription basis, orbital prediction information for OSCAR 6. Once a month, subscribers will receive satellite pass times for their particular location for the next month. The times are given, along with antenna elevation, azimuth and satellite slant range information, for all daytime (or nighttime) passes within range of the subscribing station. For those interested, the subscription cost is $36.00 per year (10¢ per day). Overseas subscribers will be charged $41.00 because of air-mail postage. Contact ITCP or AMSAT if you think you might be interested in this service, which is called "ZIPSAT."

ENCOURAGE YOUR FRIENDS TO JOINT AMSAT. HERE IS AN APPLICATION FORM.

AMSAT

RADIO AMATEUR SATELLITE CORPORATION
P. O. Box 27, Washington, D.C. 20044 USA

MEMBERSHIP APPLICATION

Name _____ Call _____ Class of License _____ Home Ph. _____

Street _____ City _____ State _____ Zip _____

Employer _____ Position _____ Bus. Ph. _____

Bus. Address _____

ARRL Member? ☐ Yes ☐ No. Club Affiliations _____

What Bands and Modes are you active on? _____

Education _____

Are you willing to accept an assignment within your field of interest? ☐ Yes ☐ No.

Please indicate how you can help AMSAT. _____

_____

_____

MEMBERSHIP QUESTIONNAIRE (OPTIONAL)

PLEASE INDICATE BELOW AREAS OF POSSIBLE CONTRIBUTION (Check those which apply.)

Engineering

- ☐ Prel. Design
- ☐ Antennas
- ☐ Tracking
- ☐ Power Systems
- ☐ Telemetry
- ☐ Structural Design
- ☐ Fabrication
- ☐ Drafting
- ☐ Other _____
- ☐ Circuit Design
- ☐ Data Proc.
- ☐ Stabilization
- ☐ Testing
- ☐ Packaging
- ☐ Data Acquisition
- ☐ Data Dissemination

Administration

- ☐ Ext. Relations
- ☐ Library
- ☐ Fund Raising
- ☐ Data Processing
- ☐ Legal
- ☐ Editorial
- ☐ Liaison with ____ _____
- ☐ Other _____ _____
- ☐ Tech. Writing
- ☐ Clerical/Sec.
- ☐ Printing/Repro.
- ☐ Photography
- ☐ Accounting
- ☐ Publications
- ☐ Tech. Translation (indicate languages) _____ _____ _____
- ☐ Education

Please describe experiments you believe AMSAT should undertake. _____

_____

_____

I understand that the statements made hereon are for the exclusive use of the Radio Amateur Satellite Corporation and will not be released to other agencies. I further understand that it is my responsibility to insure that only information which my employer does not consider proprietary will be released to AMSAT.

I hereby apply for membership in AMSAT. Attached is $5.00 to cover the first year's dues. (Donations above this amount are tax deductible.) (Dues may be prepaid for any number of years.)

Signed _____ Date _____

Form 1 (rev. 3/71)

FOR OFFICE USE ONLY

Pd _____ Cd _____ Cdd ☐ Dpl ☐

FOR OFFICE USE ONLY
NAME _____
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ARRL ____
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Eng. ____
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Exp. ____